

Stanford



Martin Pfaller

Instructor, Pediatrics - Cardiology

Curriculum Vitae available Online

Bio

BIO

Martin R. Pfaller is an Instructor in the Department of Pediatrics (Cardiology) in the group of Alison L. Marsden. He received his B.Sc., M.Sc., and Ph.D. in Mechanical Engineering from the Technical University of Munich, working with Wolfgang A. Wall. During his Ph.D., he validated an efficient yet physiologically accurate boundary condition to account for the mechanical support of the heart within its surroundings, which has been adopted by various research groups worldwide. He further demonstrated how projection-based model order reduction could speed up model personalization from patient data, such as magnetic resonance imaging or blood pressure measurements. His current work focuses on cardiovascular fluid dynamics. He developed reduced-physics models to make blood flow simulations faster and more reliable. Further, he developed a fluid-solid-growth interaction model in blood vessels. His future research will predict the heart's long-term function in heart diseases, supported by an NIH Pathway to Independence Award (K99/R00) and Stanford MCHRI Instructor K Award Support. He will quantify the risk of heart failure after a heart attack with a stability analysis validated with imaging data in swine and humans. This research will improve our understanding of biomechanical mechanisms leading to heart failure and help to identify patients at risk, enable personalized therapies, and facilitate the optimal design of medical devices. As an Assistant Professor, Martin will start his research group at Yale University in the Department of Biomedical Engineering in July 2024.

ACADEMIC APPOINTMENTS

- Instructor, Pediatrics - Cardiology
- Member, Cardiovascular Institute
- Member, Maternal & Child Health Research Institute (MCHRI)

HONORS AND AWARDS

- NIH Pathway to Independence Award (K99/R00), National Heart, Lung, and Blood Institute (2022-2027)
- Instructor K Award Support, Stanford Maternal and Child Health Research Institute (2022-2024)
- Travel Award, Additional Ventures (2022)
- Travel Award, Stanford Cardiovascular Institute (2022)
- Dissertation Award, Association of German Engineers (VDI) (2019)
- Winner Science Slam, Technical University of Munich (2017)
- Departmental Teaching Award, Technical University of Munich (2017)
- Departmental Teaching Award, Technical University of Munich (2016)
- Exchange Scholarship, German Academic Exchange Service (DAAD) (2013)
- Exchange Scholarship, Prof. Dr.-Ing. Erich Müller-Stiftung (2013)

PROFESSIONAL EDUCATION

- Postdoc, Stanford University , Pediatrics - Cardiology (2022)
- Ph.D., Technical University of Munich , Mechanical Engineering (2019)
- M.Sc., Technical University of Munich , Mechanical Engineering (2013)
- B.Sc., Technical University of Munich , Mechanical Engineering (2012)

LINKS

- Google Scholar Profile: https://scholar.google.com/citations?user=_SNRwoYAAAAJ
- LinkedIn: <https://www.linkedin.com/in/pfaller/>
- GitHub: <https://github.com/mrp089>
- NIH K99/R00 Award: <https://reporter.nih.gov/project-details/10525749>
- Future Lab Site: <http://biomechanics.yale.edu/>

Research & Scholarship

PROJECTS

- Computational Stability Analysis to Predict Heart Failure after Myocardial Infarction - Stanford University (September 1, 2022)

LAB AFFILIATIONS

- Alison Marsden, Cardiovascular Biomechanics Computation Lab (10/1/2019)

Publications

PUBLICATIONS

- **Automated generation of 0D and 1D reduced-order models of patient-specific blood flow.** *International journal for numerical methods in biomedical engineering*
Pfaller, M. R., Pham, J., Verma, A., Pegolotti, L., Wilson, N. M., Parker, D. W., Yang, W., Marsden, A. L.
2022: e3639
- **On the Periodicity of Cardiovascular Fluid Dynamics Simulations.** *Annals of biomedical engineering*
Pfaller, M. R., Pham, J., Wilson, N. M., Parker, D. W., Marsden, A. L.
2021
- **Using parametric model order reduction for inverse analysis of large nonlinear cardiac simulations** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN BIOMEDICAL ENGINEERING*
Pfaller, M. R., Cruz Varona, M., Lang, J., Bertoglio, C., Wall, W. A.
2020: e3320
- **The importance of the pericardium for cardiac biomechanics: from physiology to computational modeling** *BIOMECHANICS AND MODELING IN MECHANOBIOLOGY*
Pfaller, M. R., Hoermann, J. M., Weigl, M., Nagler, A., Chabinik, R., Bertoglio, C., Wall, W. A.
2019; 18 (2): 503–29
- **A probabilistic neural twin for treatment planning in peripheral pulmonary artery stenosis.** *International journal for numerical methods in biomedical engineering*
Lee, J. D., Richter, J., Pfaller, M. R., Szafron, J. M., Menon, K., Zanoni, A., Ma, M. R., Feinstein, J. A., Kreutzer, J., Marsden, A. L., Schiavazzi, D. E.
2024: e3820
- **A Modular Framework for Implicit 3D-0D Coupling in Cardiac Mechanics.** *Computer methods in applied mechanics and engineering*
Brown, A. L., Salvador, M., Shi, L., Pfaller, M. R., Hu, Z., Harold, K. E., Hsiai, T., Vedula, V., Marsden, A. L.
2024; 421

- **Non-invasive Estimation of Pressure Drop Across Aortic Coarctations: Validation of 0D and 3D Computational Models with In Vivo Measurements.** *Annals of biomedical engineering*
Nair, P. J., Pfaller, M. R., Dual, S. A., McElhinney, D. B., Ennis, D. B., Marsden, A. L.
2024
- **A modular framework for implicit 3D-0D coupling in cardiac mechanics** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
Brown, A. L., Salvador, M., Shi, L., Pfaller, M. R., Hu, Z., Harold, K. E., Hsiai, T., Vedula, V., Marsden, A. L.
2024; 421
- **A Fluid-Solid-Growth Solver for Cardiovascular Modeling.** *Computer methods in applied mechanics and engineering*
Schwarz, E. L., Pfaller, M. R., Szafron, J. M., Latorre, M., Lindsey, S. E., Breuer, C. K., Humphrey, J. D., Marsden, A. L.
2023; 417 (Pt B)
- **Learning reduced-order models for cardiovascular simulations with graph neural networks.** *Computers in biology and medicine*
Pegolotti, L., Pfaller, M. R., Rubio, N. L., Ding, K., Brugarolas Brufau, R., Darve, E., Marsden, A. L.
2023; 168: 107676
- **Non-invasive estimation of pressure drop across aortic coarctations: validation of 0D and 3D computational models with in vivo measurements.** *medRxiv : the preprint server for health sciences*
Nair, P. J., Pfaller, M. R., Dual, S. A., McElhinney, D. B., Ennis, D. B., Marsden, A. L.
2023
- **A homogenized constrained mixture model of cardiac growth and remodeling: analyzing mechanobiological stability and reversal.** *Biomechanics and modeling in mechanobiology*
Gebauer, A. M., Pfaller, M. R., Braeu, F. A., Cyron, C. J., Wall, W. A.
2023
- **Beyond CFD: Emerging methodologies for predictive simulation in cardiovascular health and disease.** *Biophysics reviews*
Schwarz, E. L., Pegolotti, L., Pfaller, M. R., Marsden, A. L.
2023; 4 (1): 011301
- **svMorph: Interactive Geometry-Editing Tools for Virtual Patient-Specific Vascular Anatomies.** *Journal of biomechanical engineering*
Pham, J., Wyetzner, S., Pfaller, M., Parker, D., James, D., Marsden, A.
2022
- **Blood flow modeling reveals improved collateral artery performance during the regenerative period in mammalian hearts.** *Nature cardiovascular research*
Anbazhakan, S., Rios Coronado, P. E., Sy-Quia, A. N., Seow, L. W., Hands, A. M., Zhao, M., Dong, M. L., Pfaller, M. R., Amir, Z. A., Raftrey, B. C., Cook, C. K., D'Amato, G., Fan, et al
2022; 1 (8): 775-790
- **Model order reduction of flow based on a modular geometrical approximation of blood vessels.** *Computer methods in applied mechanics and engineering*
Pegolotti, L., Pfaller, M. R., Marsden, A. L., Deparis, S.
2021; 380
- **Automatic mapping of atrial fiber orientations for patient-specific modeling of cardiac electromechanics using image registration** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN BIOMEDICAL ENGINEERING*
Hoermann, J. M., Pfaller, M. R., Avena, L., Bertoglio, C., Wall, W. A.
2019; 35 (6): e3190
- **An adaptive hybridizable discontinuous Galerkin approach for cardiac electrophysiology** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN BIOMEDICAL ENGINEERING*
Hoermann, J. M., Bertoglio, C., Kronbichler, M., Pfaller, M. R., Chabiniok, R., Wall, W. A.
2018; 34 (5): e2959
- **Multiphysics Modeling of the Atrial Systole under Standard Ablation Strategies** *CARDIOVASCULAR ENGINEERING AND TECHNOLOGY*
Hoermann, J. M., Bertoglio, C., Nagler, A., Pfaller, M. R., Bourier, F., Hadamitzky, M., Deisenhofer, I., Wall, W. A.
2017; 8 (2): 205–18
- **On the Role of Mechanics in Chronic Lung Disease** *MATERIALS*
Eskandari, M., Pfaller, M. R., Kuhl, E.

2013; 6 (12): 5639-5658

PRESENTATIONS

- Physiology, computational modeling, and impact of pericardial boundary conditions - Modelling the Cardiac Function (September 1, 2020)